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SHORT COMMUNICATION

A Newly Discovered Decaploid Species, *Angelica minamitanii* (Apiaceae)

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Angelica, one of the largest genera in Apiaceae comprises approximately 110 species distributed throughout the Northern Hemisphere. Most species are diploid ($2n = 22$), but polyploidy has occasionally been reported. This paper reports a somatic chromosome number for *Angelica minamitanii*, a recently described species endemic to Japan, as $2n = 110$ ($10x$). This is the third report of a decaploid species of *Angelica*.

Key words: *Angelica*, Apiaceae, chromosome number, decaploid

Angelica L., one of the largest genera of Apiaceae, comprises approximately 110 species distributed throughout the Northern Hemisphere (Pimenov & Leonov 1993, Mabberley 2008). In Japan, 23-27 species of *Angelica* have been reported (Kitagawa 1982, Ohba 1999, Yamazaki 2001). *Angelica minamitanii* Yamazaki was recently discovered in Miyazaki Prefecture, southwestern Japan (Minamitani 1997), and described by Yamazaki (2001) as a new species. As part of an ongoing systematic study of *A. minamitanii* and related taxa, I examined the somatic chromosome number in root tips of cultivated *A. minamitanii* [voucher specimen: *Azuma 257* (KYO)], transplanted from a wild population in Kobayashi City, Miyazaki Prefecture. I determined that *A. minamitanii* is a decaploid with $2n = 10x = 110$.

Actively growing root tips were pretreated in 2 mM 8-hydroxyquinoline solution for 5 h at 20°C. The root tips were then fixed in an ethanol-acetic acid (3:1 v/v) solution for more than 12 h at 4°C. The fixed tissues were dissociated by immersion in 1 N HCl for 10 min at 60°C, and were then soaked in Schiff's reagent (Wako Pure Chemical Industries Ltd., Osaka, Japan) for 1 h at room temperature. The well-stained portion of the root tip was excised and stained with 1% aceto-orcein solution for 10 min on a glass slide. The chromosomes in at least 2 cells per tip were counted, and at least 5 tips per individual were examined. I used a total of 3 potted individuals in this study.

The chromosome number determined for *Angelica minamitanii* was $2n = 110$ (Fig. 1). On the basis of information retrieved from Fedorov (1969), Moore (1973, 1974, 1977), Goldblatt (1981, 1984, 1985, 1988), Goldblatt & Johnson (1990, 1991, 1994, 1996, 1998, 2000, 2003, 2006, 2010), a web version of the Index to Plant Chromosome Numbers (Goldblatt & Johnson 1979–; http://www.tropicos.org/Project/IPCN), and Nishikawa (2008), the chromosome base number of *Angelica* may be $x = 11$, indicating that *A. minamitanii* is a decaploid species ($2n = 10x = 110$). Most of the ca. 93 species of *Angelica* for which the chromosome number has been determined are diploid with $2n = 22$, but at least 12 species have been reported to be tetraploid with $2n = 44$ (*A. amurensis* Schischk. (Sokolovskaya 1966), *A. chinghaiensis* Shan ex K.T. Fu (Pan *et al*. 1991), *A. cincta* H. Boissieu (Gurzenkov & Gorovoy 1971, Vasil'eva & Pimenov 1991), *A. czernaevia* (Fisch. & Mey.)

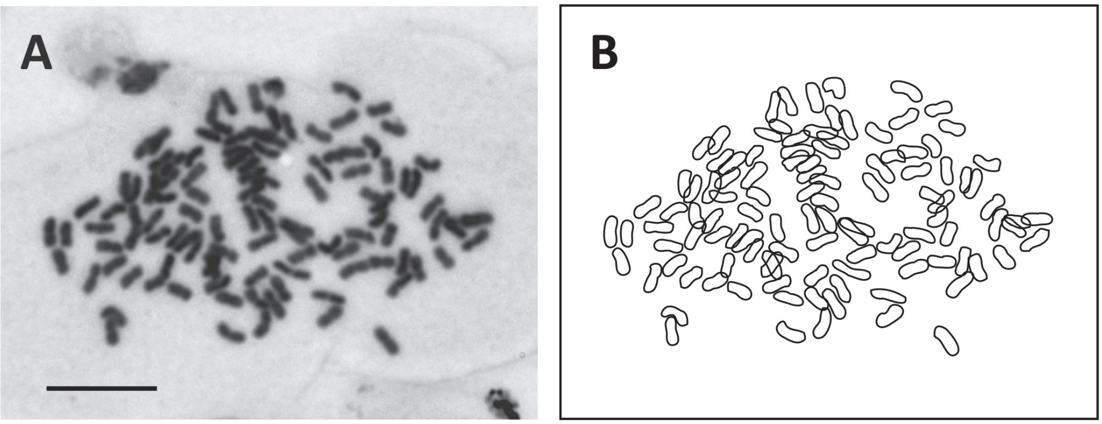

FIG. 1. Somatic chromosomes of *Angelica minamitanii* ($2n = 110$). A, micrograph; B, drawing. Scale bar indicates 10 µm.

Kitag. (Pimenov & Yarygina 1967, Gurzenkov & Gorovoy 1971, Vasil'eva & Pimenov 1991), *Angelica kingii* (S. Wats.) J. M. Coult. & Rose (Reveal & Styer 1973), *A. maximowiczii* (F. Schmidt) Benth. ex Maxim. (Vasil'eva & Pimenov 1991), *A. oncosepala* Hand.-Mazz. (Pan *et al.* 1994), *A. purpuraefolia* Chung (Do 1970), *A. sachalinensis* Maxim. (Pimenov & Yarygina 1967, Gurzenkov & Gorovoy 1971, Nishikawa 1988, Vasil'eva & Pimenov 1991), *A. songpanensis* Shan & F.T. Pu (Alexeeva *et al.* 2000), and *A. takesimana* Nakai (Lee 1972) or hexaploid with $2n = 66$ [*Angelica* sp. (Ogawa 1929), *A. breweri* A. Gray (Bell & Constance 1957), and *A. sachalinensis* (Nishikawa 1988)].

Angelica sachalinensis [*A. anomala* Avé-Lall. subsp. *sachalinensis* (Maxim.) H. Ohba], of Hokkaido and northern and central Honshu, and adjacent areas, is the only reported polyploid species of *Angelica* in Japan. Nishikawa (1988) reported the occurrence of both tetraploid ($2n = 44$) and hexaploid ($2n = 66$) individuals of *A. sachalinensis* from Hokkaido.

In addition, two decaploid species of *Angelica* have been reported from Korea and China. Do (1970) reported a chromosome number for *A. koreana* Maxim. in Korea to be $2n = 110$, and presented a clear photograph, but Pimenov & Yarygina (1967) and Gurzenkov & Gorovoy (1971) have indicated that the chromosome number of *A. koreana* is $2n = 22$ (diploid). Kitagawa (1971) reported that one of the syntypes *A. koreana* was identical to *Ostericum grosseserratum* (Maxim.) Kitag., and therefore should be treated as a synonym *O. grosseserratum*. The chromosome number of *O. grosseserratum* in Korea and China has been reported to be $2n = 18$ (Sun *et al.* 1996, Pan *et al.* 1997) or $2n = 22$ (Kwon *et al.* 2005). Because of the dissimilar chromosome numbers in the two species, the syntypes of *A. koreana* likely represent a mixed collection and should be reexamined so that a lectotype can be chosen for *A. koreana*.

Pan & Zhuang (1995) reported a chromosome number $2n = 110$ for *Angelica tianmuensis* Z.H. Pan & T.D. Zhuang from Zhejiang Province, eastern China, but without providing photographic or illustrative evidence. Subsequently, Shu *et al.* (2001) reported the chromosome number of *A. tianmuensis* as $2n = 110$, although the chromosomes in their photograph are unclear.

This study is therefore the third report of a decaploid species in *Angelica*. I am now interested in whether these three decaploid species are phylogenetically closely related. First, however, I hope to determine the decaploid lineage of *A. koreana* examined by Do (1970) in Korea. Taxonomic studies, including molecular phylogenetic analysis, intraspecific variation of ploidy levels, and morphological variation, are required to clarify the taxonomic status and elucidate the evolutionary history of *A. minamitanii* and related species.

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